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(71) Applicant: 000005049
Sharp Corporation
22-22, Nagaike-cho Abeno-ku Osaka-shi

(72) Inventor: Shinya KISHI
Sharp Corporation
22-22, Nagaike-cho Abeno-ku Osaka-shi

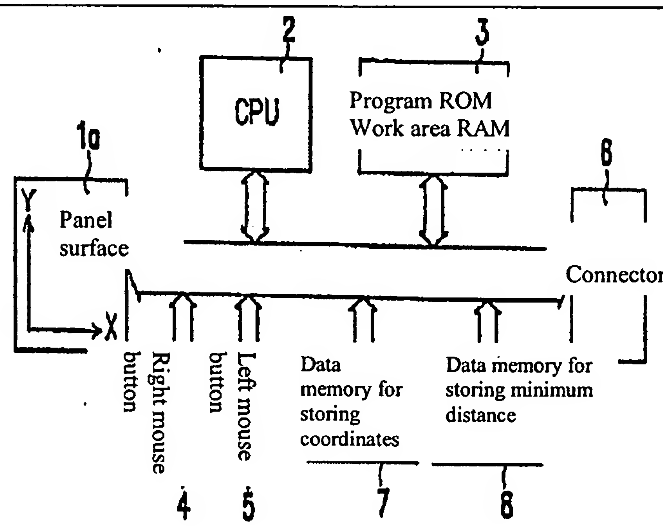
(74) Representative: Shusaku YAMAMOTO, Patent attorney

(54) [Title of the Invention:]
Jog Dial Emulation Input Device

(57) [Abstract]

[Problem to be Solved:] To indicate a long-stroke cursor movement or to increase or decrease in a numeric value easily within a small operating area by tracing a finger A in a circle or an arc on a panel surface 1a of a mouse pad 1 to perform a jog dial-type input operation.

[Means to Solve:] [The jog dial emulation input device] comprises a mouse pad 1 for detecting coordinates on a panel surface 1a that are touched by a finger A, and a rotation direction detector means for determining the rotation, clockwise or counterclockwise, of the trajectory of movement of coordinates detected by the mouse pad 1.



[Claims]

[CLAIM 1] A jog dial emulation input device comprising: a coordinate input device for inputting location coordinates from a finger or pointing device caused to touch or approach a panel surface; and rotation direction detection means for determining whether the trajectory of the location coordinates inputted by the coordinate input device rotates in the clockwise or counterclockwise direction.

[CLAIM 2] A jog dial emulation input device as cited in Claim 1, comprising direction indicating means for converting the rotation direction determined by the rotation direction detection means into a signal indicating the direction of a 1-dimensional displacement, and for causing the input location coordinates to move in accordance with the rotation direction.

[CLAIM 3] A jog dial emulation input device as cited in Claim 1 or Claim 2, comprising rotation direction display means for displaying a display indicating the rotation direction determined by the rotation direction detection means.

[CLAIM 4] A jog dial emulation input device as cited in any one of Claim 1 to Claim 3, comprising rotation direction sound generation means for generating sound indicating the rotation direction determined by the rotation direction detection means.

[CLAIM 5] A jog dial emulation input device as cited in any one of Claim 1 to Claim 4, comprising input precision modifying means for modifying the numeric value of a minimum distance for the rotation detection means to recognize, based on input from any one input device, line segment elements of a trajectory of movement from a previous location coordinate to a present location coordinate.

[CLAIM 6] A jog dial emulation input device as cited in any one of Claim 1 to Claim 5, comprising mouse emulation means for rendering location coordinates inputted by the coordinate input device as location coordinates from mouse input; and input switching means for switching, based on input from any one input device, between input from the mouse emulation means and input from the rotation direction detection means.

[CLAIM 7] A jog dial emulation input device as cited in any one of Claim 1 to Claim 6, wherein the rotation direction detection means compares the line segment slope of a previously recognized trajectory with the line segment slope of the presently recognized trajectory and determines whether the rotation direction is clockwise or counterclockwise.

[Detailed Explanation of the Invention]

[0001]

[Technical Field of the Invention] The present invention relates to a jog dial emulation input device that performs jog dial type input in a computer or the like to indicate the direction of cursor movement or the like based on the tracing of a circle or an arc.

[0002]

[Prior Art] With a computer or the like, an operator sometimes indicates the direction of 1-dimensional displacement (for example, up/down, left/right, increase/decrease, dark/light, positive/negative, etc.). When selecting from a list of menu items displayed vertically or horizontally on the screen of a display device, for example, an operation

whereby a selection cursor is moved up/down or left/right to a position above the one item to be selected is required. Moreover, when drawing a picture on a display screen or the like, the need may arise for the cursor to move in only one direction, such as the X-axial direction or Y-axial direction. Additionally, when setting such numeric values as time, font size, count value of a counter, thermostat temperature, mouse resolution and the like, an operation box or the like may be opened on the screen and the numeric values displayed therein increased or decreased. The following operations also indicate the direction of a 1-dimensional displacement.

[0003]
- Operation to scroll up or down the display screen
- Operation to enlarge or shrink the display screen
- Operation to move frames forward or backward when editing images
- Operation to adjust the display screen contrast, brightness, focus, tint, color density, etc.
- Operation to adjust the sound volume, sound quality, stereo balance, etc.
- Operation to select a station on a TV (television), radio, cable broadcast, wireless frequency, etc.

When using a keyboard to perform the above operations, the user can press one of a set of up/down or left/right arrow keys indicating the direction so as to cause the cursor to move, a numeric value or other adjustment parameter to increase/decrease, and so on. Also, when using a mouse, the cursor can be caused to track the movement of the mouse on a mouse pad, a scroll bar tab display indicating an increase/decrease of a numeric value or other adjustment parameter can be dragged, or an arrow button display or the like clicked to increase/decrease those values.

[0004] Furthermore, Japanese Unexamined Patent Application Publication No. H7-104964 cites an invention in which menu items are selected using a stylus pen or the like. This invention provides a gesture recognition area for each item on a display screen, and when the indicated position of a stylus pen or the like is within one of the gesture recognition areas, gesture recognition is performed to select and determine the [menu] item. Also, Japanese Unexamined Patent Application Publication No. H6-12493 cites an invention wherein gestures inputted by a stylus pen, a mouse, or the like are recognized by a DP (dynamic programming) matching method that has been used in voice recognition and the like.

[0005] Furthermore, a jog dial input device is a special input device for indicating the abovementioned direction of 1-dimensional displacement. As shown in FIG. 24, the jog dial input device is comprised of a jog dial 21 rotatably mounted on a main body and a concave portion 21a located at an off-center position on the jog dial 21. Then, when a user places his/her finger tip A into the concave portion 21a and rotates the jog dial 21, jog dial pulses (for example, two-phase pulses having a leading or lagging phase depending on the rotation direction) corresponding to the rotational direction are transmitted to a computer. Accordingly, device drivers on the computer side input these jog dial pulses, determine whether the rotational direction of the jog

dial 21 is clockwise (rotation toward the right) or counterclockwise (rotation toward the left), and the results of this determination are passed to an application program or the like so as to enable indication of the direction of 1-dimensional displacement. Also, by treating the jog dial pulses as mouse pulses in the X-axial or Y-axial direction, the mouse input location coordinates stored internally by the device drivers can be moved. Furthermore, the amount of displacement in the direction indicated here can be expressed with the number of jog dial pulses or the like. A method in which clockwise or counterclockwise rotation of this type of jog dial input device corresponds to positive or negative instructions, for example, is utilized in instructing the forwarding direction of frames with a video editing machine, and is highly intuitive.

[0006]

[Problems to be Solved by the Invention] However, when pressing an arrow key on a keyboard or the like to indicate the direction of displacement, if an attempt is made to indicate a long-stroke displacement for a large cursor travel distance or a large increase/decrease in a numeric value, there is a problem in that the key must be pressed repeatedly, or held down for a long time with a key repeat function, and the operation is extremely troublesome.

[0007] Moreover, when using a mouse to indicate a long-stroke displacement, the mouse must be moved over a long distance or moved quickly (if the resolution [of the mouse] is automatically adjusted), and the [mouse] travel distance will become too long, extending beyond the mouse pad. Accordingly, there are problems in that moving the hand holding the mouse over a long distance or quickly is a troublesome operation, and if [such movement] might extend beyond the mouse pad, a complicated operation is performed in which the mouse is lifted up from the mouse pad before completion of the travel, returned to its original location, and then moved again. Furthermore, operations to increase/decrease numeric values and other adjustment parameters or to darken/lighten [the display] by clicking on arrow button displays or the like or pressing and holding down mouse buttons numeric value incur the same sorts of problems as with key operation.

[0008] Additionally, the use of stylus pen on a tablet separate from the display screen involves the same circumstances as when a mouse is used. For example, a problem also occurs in the invention cited in Japanese Unexamined Patent Application Publication No. H7-104964, as shown in FIG. 25, when a stylus pen 22 is operated on a separate tablet 23, in order to move a cursor bar 25 above selection item 1 at the top portion of a display screen 24 to a selection item 5 at the bottom portion [of the display screen], the stylus pen 22 downward over a long distance while in close proximity to the tablet 23, and operation becomes complicated, requiring the hand holding the stylus pen 22 to move over a long distance, the stylus pen to be lifted up before completion of the travel, returned to its original location, and then moved again.

[0009] The above problems can all be eliminated by using a jog dial input device with which [the user] rotates a jog dial 21 with a finger tip A to indicate the direction of displacement. However, connecting a jog dial input device to a computer or the like in order to indicate the direction of displacement invites the problems of higher cost and additional required operating space on a desk or the like.

[0010] Additionally, the invention of Japanese Unexamined Patent Application Publication No. H7-104964 recognizes gestures from a stylus pen or the like and then selects and determines [a menu item], and this type of gesture recognition processing required complicated computations. For example, the invention of Japanese Unexamined Patent Application Publication No. H6-12493 performs a complicated computation for the angular displacement θ, as shown in Equation 1, to perform gesture recognition processing based on DP matching.

[0011]

[Equation 1]

$$\theta = \cos^{-1}\frac{VX_1 \cdot VX_0 + VY_1 \cdot VY_0}{\sqrt{(VX_1^2 + VY_1^2)\cdot(VX_0^2 + VY_0^2)}}$$

[0012] That is, as shown in FIG. 26, the coordinates of a stylus pen or the like move from P0, through P1, to P2. Also, the change from coordinate P0 to coordinate P1 is considered a previous vector, and the change from coordinate P1 to coordinate P2 is considered to be the present vector, where the previous vector components are represented by (VX0, VY0) and the present vector components are represented by (VX1, VY1). Thus, the inner product of the previous and present vectors is expressed as Equation 2.

[0013]

[Equation 2]

$$VX_1 \cdot VX_0 + VY_1 \cdot VY_0$$

[0014] Moreover, the inner product is also expressed by Equation 3, where θ is the angle formed by the previous and present vectors.

[0015]

[Equation 3]

$$\sqrt{VX_1^2 + VY_1^2} \cdot \sqrt{VX_0^2 + VY_0^2} \cdot \cos\theta$$

[0016] Setting Equation 2 equal to Equation 3, it is understood that the vector angular displacement θ can be obtained by computing Equation 1 above. Furthermore, the angular displacement θ of the vector is within the principle value range of $0 \leq \theta \leq \pi$, and an angle in the range of $-\pi \leq \theta \leq \pi$ is obtained by appending positive and negative signs to the components perpendicular to the paper surface of FIG. 26 in the outer product of these vectors in Equation 4

[0017]

[Equation 4]

$$VX_1 \cdot VY_0 - VX_0 \cdot VY_1$$

[0018] Accordingly, in the gesture recognition process, a complicated computation must be performed coordinate inputted by

a stylus pen or the like, thereby giving rise to the problems of increased load on the computation processing device and difficulty in ensuring real-time operation.

[0019] In consideration of the abovementioned circumstances, an object of the present invention is to provide a jog dial emulation input device capable of moving a cursor or increasing/decreasing a numeric value and so on in response to an operation of tracing a circle or an arc on a touch panel-type mouse pad.

[0020]

[Means to Solve the Problems] The jog dial emulation input device of the present invention comprises a coordinate input device for inputting location coordinates from a finger or pointing device caused to touch or approach a panel surface, and rotation direction detection means for determining whether the trajectory of the location coordinates inputted by the coordinate input device rotates in the clockwise or counterclockwise direction, thereby achieving the above object.

[0021] Moreover, the jog dial emulation input device of the present invention preferably comprises direction indicating means for converting the rotation direction determined by the rotation direction detection means into a signal indicating the direction of a 1-dimensional displacement and for causing the input location coordinates to move in accordance with the rotation direction.

[0022] Further, the jog dial emulation input device of the present invention preferably comprises rotation direction display means for displaying a display indicating the rotation direction determined by the rotation direction detection means.

[0023] Further, the jog dial emulation input device of the present invention preferably comprises rotation direction sound generation means for generating sound indicating the rotation direction determined by the rotation direction detection means.

[0024] Further, the jog dial emulation input device of the present invention preferably comprises input precision modifying means for modifying the numeric value of a minimum distance for the rotation detection means to recognize, based on input from any one input device, line segment elements of a trajectory of movement from a previous location coordinate to a present location coordinate.

[0025] Further, the jog dial emulation input device of the present invention preferably comprises mouse emulation means for rendering location coordinates inputted by the coordinate input device as location coordinates from mouse input, and input switching means for switching, based on input from any one input device, between input from the mouse emulation means and input from the rotation direction detection means.

[0026] Further, in the jog dial emulation input device of the present invention, the rotation direction detection means preferable compares the line segment slope of a previously recognized trajectory with the line segment slope of the presently recognized trajectory and determines whether the rotation direction is clockwise or counterclockwise.

[0027] Operation [of the present invention] is explained below.

[0028] With the above-described constitution, using an ordinary coordinate input device and performing an operation of circle or arc tracing, the same input can be implemented as with a jog dial input device. Furthermore, a rotation direction detector

means may be provided as software or hardware attached with the coordinate input device, or as a device driver or the like of the computer connected to this coordinate input device. In the case where the rotation direction detector means is provided attached to the coordinate input device and the determined direction of rotation is transmitted to the computer as a jog dial pulse, the device driver for use with the jog dial input device can be used directly on the computer side to perform input processing.

[0029] Moreover, with the above-described constitution, using an ordinary coordinate input device and performing an operation of circle or arc tracing, the operation of tracing a straight line with a mouse, for example, can be emulated, and therefore, long-stroke operations can be performed within a small operating area. An ordinary mouse transmits to a computer the same pulses as a jog dial pulse indicating the travel direction and distance in both the X and Y axis, and based on these pulses, the device driver changes the internally stored input location coordinates. Therefore, if a direction indicating means provided on the coordinate input device side transmits to the computer a signal of these types of pulses indicating the displacement direction, input processing can be performed directly by the device driver for the mouse. Moreover, if signals indicating the displacement direction are inserted into a key buffer and processed as key codes of the arrow keys on the keyboard, the input operation of these arrow keys can also be emulated. Additionally, if the direction indication means is able to move internally stored input location coordinates, rather than the device driver for the mouse, [the direction indication means] will also be able to process inputted coordinate positions. The direction indication means may be provided integrally with the rotation direction detection means, as a separate attachment for the coordinate input device, a device driver for the computer side, etc.

[0030] Furthermore, the above-mentioned constitution makes it possible to trace circles or arcs correctly while verifying the display of a display device

[0031] Furthermore, the above-mentioned constitution makes it possible to trace circles or arcs correctly while [listening to] a verification sound generated by a sound generator device such as a speaker or buzzer.

[0032] Furthermore, the above-mentioned constitution makes it possible to modify the minimum distance setting at which inputted location coordinates form line-segment elements of the trajectory, and therefore the resolution when tracing a circle or arc can be changed. This modification may be implemented with a special key operation or numeric input from a keyboard, or may be implemented by a special operation in the jog dial mode or mouse mode (for example, an operation to open an operation box on the screen of the display device and increase/decrease a numeric value) or the like.

[0033] Furthermore, the above-mentioned constitution enables easy switching between jog dial mode input processing and mouse mode input processing. The switching operation may be implemented such that jog dial mode input processing is active only while a particular key is pressed down on the keyboard, a [certain] mode of input processing remains active after a key

corresponding to that mode has been pressed once, or the input processing [mode] is toggled each time a key is pressed. Moreover, switching may also be implemented with operations on other input devices, in addition to keyboards.

[0034] Furthermore, the above-mentioned constitution enables the rotation direction detector means to determine the rotation direction with a simple computation based on the slopes of line segments of the trajectory, and thereby easily ensuring real-time operation. The slopes of the line segments can easily be obtained by division, thereby eliminating the need for complicated angular computations as in the case of gesture recognition processing. Moreover, the rotation direction can generally be determined to be clockwise when the line segment slopes are becoming smaller and only if the slope changes from negative to positive, will the slopes increase with clockwise rotation. Thus, the rotation direction can also be determined easily by categorizing the line segment slopes and then performing a comparative computation.

[0035]

[Embodiments] Embodiments of the present invention are explained below.

[0036] [Embodiment 1] FIGS. 1 to 19 illustrate a first embodiment of the present invention. FIG. 1 is a block diagram illustrating a hardware configuration of a mouse pad; FIG. 2 is a plan view of the mouse pad; FIG. 3 is a block diagram illustrating a hardware configuration of a computer that connects to the mouse pad; FIG. 4 is a flowchart explaining the processing of inputs from the mouse pad; FIG. 5 is a flowchart explaining the processes performed for coordinates inputted from a mouse pad; FIG. 6 is a flowchart explaining the jog dial mode processing of inputs from a mouse pad; FIG. 7 is a flowchart explaining the processes performed to determine the rotation method of [inputs from] a mouse pad; FIG. 8 is an explanatory diagram for explaining a case in which the [direction of] movement of coordinates suddenly becomes inverted; FIG. 9 is an explanatory diagram for explaining a case in which the coordinates move in a clockwise rotation; FIG. 10 is an explanatory diagram for explaining a case in which the coordinates move in a counterclockwise rotation; FIG. 11 is an explanatory diagram for explaining a case in which the coordinates move in a clockwise rotation; FIG. 12 is an explanatory diagram for explaining a case in which the coordinates move in a clockwise rotation; FIG. 13 is an explanatory diagram for explaining a case in which the coordinates move in a counterclockwise rotation; FIG. 14 is an explanatory diagram for explaining a case in which the coordinates move in a counterclockwise rotation; FIG. 15 is an explanatory diagram for explaining a case in which the coordinates move in a clockwise rotation; FIG. 16 is an explanatory diagram for explaining a case in which the coordinates move in a clockwise rotation; FIG. 17 is an explanatory diagram for explaining a case in which the coordinates move in a counterclockwise rotation; FIG. 18 is an explanatory diagram for explaining a case in which the coordinates move in a counterclockwise rotation; FIG. 19 is an explanatory diagram for explaining input processing when the coordinates move continuously.

[0037] This embodiment is explained using a mouse pad 1, as shown in FIG. 2, as a coordinate input device. The mouse pad 1 has an approximately 5-cm-square touch panel surface 1a and detects the location coordinates of an operator's finger tip A touching the panel surface 1a, and thus is able to emulate the operation of a mouse. The mouse pad 1 is also provided with left and right mouse buttons at a location not shown in the drawing. The mouse pad 1 has been developed as a coordinate input device alternative to a general mouse, and is also known as a touch mouse, touch pad, stylus pad, stylus mouse and glide point. Furthermore, coordinate input devices such as an ordinary mouse or stylus pen may be used instead of this type of mouse pad 1.

[0038] The mouse pad 1 is configured with a microcomputer system equipped with a CPU (central processing unit) 2 as shown in FIG. 1. The CPU 2 executes a program stored in a ROM (read-only memory) in a memory 3. That is, the program performs mouse mode input processing by reading out the coordinates of the location where the panel surface 1a was touched by the fingertip A, detecting the pressed states of a left mouse button 4 and a right mouse button 5, and outputting these inputted location coordinates and the pressed states of these mouse buttons 4 and 5 and via a connector 6. Moreover, the program also performs jog dial mode input processing by storing detected prior-to-previous, previous and present location coordinates sequentially in a coordinate storage memory 7, and using a RAM (random access memory) work area in the memory 3 and while referring to the value of a minimum distance Lmin stored in a minimum distance storage memory 8, determining whether the rotation direction of the trajectory of these location coordinates is clockwise or counterclockwise, and outputting the determined result via the connector 6. Furthermore, the program is also capable of storing in a minimum distance storage memory 8 new minimum distance Lmin settings transmitted from the connector 6.

[0039] The mouse pad 1 is used as an input device and the connector 6 is connected to a connector 10 of a computer shown in FIG. 3. A CPU 11 of the computer executes a system program stored in a memory 12 configured from RAM and ROM. A device driver in the system program acquires the location coordinates transmitted from the mouse pad 1 via the connector 10, the pressed state of mouse buttons 4 and 5, and the result of a determination of the rotation direction. Moreover, the device driver is also able to transmit via the connector 10 to the mouse pad 1 the value of the minimum distance Lmin setting. Furthermore, the device driver in the system program accepts key inputs from a keyboard 13, implements a display on a display device 15 by using a display driver 14, and generates sound from a speaker 17 by using a sound driving circuit 16. A buzzer may be used instead of the speaker 17.

[0040] The above-described system program reads out an application program from a hard disk device 18, stores it in the memory 12, and executes the application program automatically or according to instructions based on an operation from the keyboard 13 or the mouse pad 1. The application program, via the device driver of the system program, processes input from the mouse pad 1 and the keyboard 13, implements a display on the display device 15 and generates sound through the speaker 17. A RAM 19 is used as a work area for the system program and application program.

[0041] Furthermore, with the above-described configuration, the mouse pad 1 sends to the computer the result of a determination of the rotation direction in response to input in the jog dial mode device as well as location coordinates in response to input in the mouse mode. However, the mouse pad 1 may also [be configured to] output only location coordinates and the like, with the determination of rotation direction being performed by the device driver on the computer side when processing inputs in the jog dial mode. Moreover, the mouse pad 1 may [be configured to] output pulses during mouse mode operation and jog dial pulses during jog dial operation, with the pulses being processed by the device driver on the computer side.

[0042] The operations of the computer and the mouse pad 1, which processes inputs in the jog dial mode, having the above-described configurations will be explained with reference to flowcharts shown in FIGS. 4 to 7. In these flowcharts, the operations of the device driver and the application on the computer side and the program on the mouse pad 1 side are described collectively. In these flowcharts, variables indicated by the same symbols all have a common value.

[0043] Firstly, at a first step (hereafter referred to as "S") 1 shown in FIG. 4, coordinates are input from the panel surface 1a of the mouse pad 1. The inputting of coordinates involves the process of assigning the X coordinate of the panel surface 1a touched by the fingertip A to the [value of an] X variable (S21) and assigning the Y coordinate to the [value of a] Y variable (S22) as shown in FIG. 5. Next, as shown in FIG. 4, the values of variables X and Y obtained from the inputted coordinates are assigned to variables X1 and Y1 (S2). The variables X1 and Y1 are provided in the coordinate storage memory 7 and store the previous coordinates. Moreover, a variable N is initialized to "0" (S3), and the minimum distance Lmin in the minimum distance storage memory 8 is set to a default value (S4). In the case of the above-described configuration, these initialization processes may be implemented with only a program on the mouse pad 1 side. Moreover, these initialization processes may also be executed by instructions from the computer side whenever jog dial mode input is requested by the application program or the like, however, coordinates may be regularly input from the panel surface 1a in the mouse pad 1, and [the initialization processes] executed automatically whenever it is detected that the fingertip A is touching the panel surface 1a.

[0044] After the above-described initialization processes are complete, jog dial mode input processing is performed (S5). In the jog dial mode input processing, as will be explained later in detail with reference to FIGS. 6 and 7, a variable G that indicates the results of the determined direction of rotation (having a value of "1" if clockwise rotation or "-1" if counterclockwise rotation) when a fingertip A traces a circle or arc on the panel surface 1a and a variable D that indicates whether the direction of rotation has been determined (having a value of "1" if the direction of rotation is determinable, or "0" if indeterminable) are set from the mouse pad 1 side. It is explained that the application program of the computer directly references, as shared memory, variables G and D that have been set from the mouse pad 1 side, but usually the device driver of the system program acquires these values through the connector 10, and the application program issues system calls, and references [these values] in response to the reception of an event of the like.

[0045] When variables G and D have been set by the jog dial mode input processing, first, the variable D is inspected as to whether its value is "1" (S6), and then the variable G is inspected as to whether it is "1" (S7). Then, when variables G and D are both "1," the rotation direction is determined to be clockwise, and processing is performed for the case where the rotation direction of the jog dial input is clockwise (S8); when the variable D is "1" but the variable G is "-1," the rotation direction is determined to be counterclockwise, and processing is performed for the case where the rotation direction of the jog dial input is counterclockwise (S9). Moreover, when the variable D is "0," the rotation direction is indeterminable, and processing is performed for the case where there is no jog dial input (S10). Then, after any one of the processes of S8 to S10 has been completed, [the program] returns to the jog dial input processing of S5, and repeats the above processes. The processes of S6 to S10 are usually executed by the application program, and when selecting a menu item, for example, the cursor is moved up or down, one item at a time, by the process of S8 and S9. Then, when jog dial mode inputs are no longer required, all processes of FIG. 4 are terminated.

[0046] In the above-described jog dial mode input processing of S5, as shown in FIG. 6, first, a program on the mouse pad 1 side inputs coordinates from the panel surface 1a (S31). These processes are constantly performed on the mouse pad 1 side, and the application program may reference variables G and D as necessary. The inputting of coordinates is processed in the same manner as shown in the above-described S1 of FIG. 5. Next, variables X and Y obtained from the inputted coordinates are assigned to variables X2 and Y2 (S32). The variables X2 and Y2 are provided in the coordinate storage memory 7 and store the present coordinates. Moreover, the difference in X-axial direction components between the previous and present coordinates (X2 - X1) is computed, and assigned to a variable VX, and the difference in Y-axial direction components between the previous and present coordinates (Y2 - Y1) is computed and assigned to a variable VY (S33). Then, based on the values of variables VX and VY, the distance between the previous and present coordinates is computed, a determination is made as to whether this distance is greater than or equal to the minimum distance Lmin stored in the minimum distance storage memory 8 (S34), and if less than the minimum distance Lmin, the variable D is assigned a value of "0" (indeterminable) (S35), and the jog dial mode input processing is terminated. That is, the trajectory in which a circle or arc is traced on the panel surface 1a is recognized by the movement of coordinates as successive linear elements and the rotation direction can be determined by comparing two consecutive line segments. However, if the distance between the previous and present coordinates is less than the minimum distance Lmin, the

finger tip A has not moved a distance sufficient for determining the rotation direction, and in this case, the inputted coordinates are cancelled. Accordingly, even if the same circle or arc is traced, the number of times the rotation direction is determined will differ if the minimum distance Lmin differs, and the minimum distance Lmin indicates the resolution of the jog dial mode input.

[0047] At S34, if the distance between coordinates was determined to be greater than or equal to the minimum distance Lmin, the variable VX is inspected as to whether its value is "0" (S36), and if not "0," the line segment slope (VY/VX) is computed and assigned to a variable S_{12} (S37). The variable S_{12} stores the slope of the present line segment (line segment from the previous to the present coordinates). The processing of S36 is to avoid a divide-by-zero error when performing this computation. Accordingly, when the variable VX is "0" (when the coordinates move along the Y-axial direction), since the rotation direction can be detected the next time inputs are processed, a variable N is assigned a value of "1" (S36'), the variable D is assigned a value of "0" (indeterminable) (S35), and then jog dial mode input processing is terminated, thereby cancelling the present inputted coordinates.

[0048] After the slope of the present line segment has been assigned to the variable S_{12}, a determination is made as to whether the variable N is "0" (S38), and if "0," the variable N is assigned a value of "1" (S39) and the variable D is assigned the value "0" (indeterminable) (S40). Then, the value of the variable S_{12} is shifted to a variable S_{01} (S41), and the values of variables X1, Y1 and X2, Y2 are shifted to variables X0, Y0 and X1, Y1, respectively (S42). Since the variable N is initialized by the above-described S3 process, [the variable N] must be determined to be "0" when the above-described S5 is first called. If the variable N becomes "1," valid coordinates have been inputted at least twice and the rotation direction is determinable. The variable S_{01} stores the slope of the previous line segment, and variables X0 and Y0 are provided in the coordinate storage memory 7 to store the prior-to-previous coordinates. Accordingly, the shift processing of S41 and S42 prepares for the next call. Moreover, as a result of the next call and thereafter, in the case where it has been determined in S36 that the variable N is not "0," processing to determine the rotation direction is executed (S43). As will be described in detail with reference to FIG. 7, the value of the variable G, which indicates the determined result of the rotation direction, is usually set during the processing for determining the rotation direction, and therefore, after this processing is completed, the variable D is assigned a value of "1" ([rotation direction has been] determined) (S44), and then the shift

processing of S41 and S42 is performed. After the completion of this shift processing, the jog dial mode input processing is terminated, and [the program] returns to process [the steps of] S6 and thereafter, shown in FIG. 4.

[0049] In the above-described processing to determine the rotation direction in S43, as shown in FIG. 7, the distance between the prior-to-previous coordinates (X0, Y0) and the present coordinates (X2, Y2) is computed first, and then a decision is made as to whether this distance is greater than or equal to the minimum distance Lmin (S51). Then, if this distance is less than the minimum distance Lmin, the sign of the value of variable G is changed (S52) and the determination process is terminated. In the case where the prior-to-previous and the present coordinates are in close proximity, as shown in FIG. 8, the previous coordinates (X1, Y1) move away from the prior-to-previous coordinates (X0, Y0), and then the present coordinates (X2, Y2) again return to approach the prior-to-previous coordinates (X0, Y0). It is conceivable that, in this case, the direction of rotation was reversed suddenly while the fingertip A was tracing a circle or arc, and therefore the sign of the variable G that stores the previous judgment results is inverted. This reversal of rotation can also be determined during the next processing of jog dial mode inputs, and therefore the processing of S51 is not absolutely essential. Performing this type of determination, however, enables a more rapid determination and improved operation response. Although not shown in the flowchart, the determination of a reversal of rotation must not be attempted until after the variable G has been set at least once. Furthermore, storing the square of the value of the minimum distance Lmin enables the square root calculation in S51 and the above-described S34 to be omitted. Moreover, the determination of a sudden reversal of rotation in S51 does not require usage of the minimum distance Lmin used in the S34 process, and another appropriate value may be used.

[0050] If the processing of S51 determines that there is no sudden reversal of rotation, a judgment is made as to whether the variable S_{12} and the variable S_{01} match (S53). In the case where the variable S_{12} and the variable S_{01} match, the previous and the present line segments are connected linearly and the rotation direction is indeterminable, and therefore the variable D is assigned a value of "0" (indeterminable) (S54), and [the program] proceeds to S42 of FIG. 6. However, at this time, the jog dial mode input processing can be terminated without transferring to S42.

[0051] In the case where it has been determined that the variable S_{12} and the variable S_{01} do not match, a determination is made as to whether the movement from the prior-to-previous coordinates, via the previous coordinates, to the present coordinates is a monotonous increase or decrease along the Y-axial direction (S55). Then, in the case of neither a monotonous increase nor decrease, the relative sizes of

variable S_{12} and the variable S_{01} are compared (S56), and if the variable S_{12} indicating the slope of the present line segment is smaller, the variable G is assigned a value of "1" (clockwise rotation) (S57), or if the variable S_{12} is larger, the variable G is assigned a value of "-1" (counterclockwise rotation) (S58), and then the process of determining [the rotation] is terminated. In the case where [the movement of coordinates] does not increase or decrease monotonously in the Y-axial direction, the coordinate movement is as shown in FIGS. 9 and 10. In the case of FIG. 9, in both [instances] the variable S_{12} is smaller and therefore a determination can be made that the rotation is clockwise. In the case of FIG. 10, in both [instances] the variable S_{12} is larger and therefore a determination can be made that the rotation is counterclockwise. Furthermore, in the drawings of FIGS. 9 and 10, the rightward direction is the positive X-axial direction and the upward direction is the positive Y-axial direction. Moreover, this convention also applies to each of the subsequent drawings.

[0052] In the case where the processing of S55 has determined that the movement of coordinates increases or decreases monotonously in the Y-axial direction, first a determination is made as to whether the variable S_{01} is negative and the variable S_{12} is positive (S59), and if [the variable S_{01} is negative and the variable S_{12} is positive], the variable G is assigned a value of "1" (clockwise rotation) (S60), and the process of determining [the rotation] is terminated. The coordinate movement shown in FIG. 11 corresponds to a monotonous decrease, and the coordinate movement shown in FIG. 12 corresponds to a monotonous increase, and in both cases a determination can be made that the rotation is clockwise. Next, a determination is made as to whether the variable S_{01} is positive and the variable S_{12} is negative (S61), and if [the variable S_{01} is positive and the variable S_{12} is negative], the variable G is assigned a value of "-1" (counterclockwise rotation) (S62), and the process of determining [the rotation] is terminated. The coordinate movement shown in FIG. 13 corresponds to a monotonous decrease, and the coordinate movement shown in FIG. 14 corresponds to a monotonous increase, and in both cases a determination can be made that the rotation is counterclockwise.

[0053] If the signs of variables S_{01} and S_{12} are both the same, [the program] processes S59 and S61 and then jumps to the above-described S56. Accordingly, the rotation direction is determined according to the relative sizes of the values of the variable S_{12} and the variable S_{01}. Of course, when comparing

negative values, the one having a smaller absolute value and a gentler slope is the larger value. Both [instances] of coordinate movement shown in FIG. 15 are of monotonous decrease and both [instances] of coordinate movement shown in FIG. 16 are of monotonous increase; [these drawings] correspond to the case where the variable S_{01} is larger [than the variable S_{12}], and therefore a determination can be made that the rotation in both is clockwise. Moreover, both [instances] of coordinate movement shown in FIG. 17 are of monotonous decrease and both [instances] of coordinate movement shown in FIG. 18 are of monotonous increase; [these drawings] correspond to the case where the variable S_{12} is larger [than the variable S_{01}], and therefore a determination can be made that the rotation in both is counterclockwise.

[0054] As a result, in the processes of S55 to S62, as a rule, the rotation is determined to be clockwise when the line segment slopes decrease ($S_{01} < S_{12}$) (S57), and the rotation is determined to be counterclockwise when the line segment slopes increase ($S_{01} \geq S_{12}$) (S58). However, as shown in FIGS. 11 to 14, these line segments increase or decrease monotonously in the Y-axial direction, and the case in which the previous and present line segment slopes have different signs is an exception. That is, when the sign changes from negative to positive ($S_{01} < 0$ and $S_{12} > 0$), the rotation is [determined to be] clockwise regardless of the increasing slope (S60), and when the sign changes from positive to negative ($S_{01} > 0$ and $S_{12} < 0$), the rotation is [determined to be] counterclockwise regardless of the decreasing slope (S62).

[0055] An actual operating example of the above-described flowchart is explained below. Here, the coordinates where the fingertip A touched the panel screen 1a move from P0 to P12 as shown in FIG. 19. Table 1 lists the X- and Y-axial components of these P0 to P12 coordinates, the distance from the previous coordinate as computed in S34, the slope of the present line segment as computed in S37, and the values of variables N, D and G.

[0056]

[Table 1]

Coordinate symbol	Coordinate		Distance from previous coordinate	Slope of present line segment	Result		
	X	Y			N	D	G
P0							
P1	[See original for figures.]						
P2							
P3							
P4							
P5							
P6							
P7							
P8							
P9							
P10							
P11							
P12							

[0057] Moreover, the minimum distance Lmin is set to 10.

[0058] The coordinate P0 is input during the process of [step] S1. Also, the variable N is initialized to "0" in the subsequent process of S3. When moving to coordinate P1, the distance from the previous coordinate P0 is 5.83, which is smaller than the minimum distance Lmin, and therefore in the process of S35 the variable D is assigned a value of "0" indicating that [the rotation direction] is indeterminable, and the process of S10 for the case where there is no S10 jog dial input is executed. Moreover, when moving to coordinate P2, the distance from the previous coordinate P0 [sic] is 11.18, which is larger than the minimum distance Lmin, and therefore the slope is computed to be 0.50 in the process of S37 and the variable N is assigned a value of "1" in S39 indicating that [the rotation direction] is determinable, but because the variable D is assigned a value of "0" in the process of S40, the indeterminable [rotation direction] state continues. Additionally, when moving to coordinate P3, the distance is larger than the minimum distance Lmin; the slope is again computed by the process of S37 to be 0.30, the variable G is assigned a value of "1" at S57, and the variable D is assigned a value of "1" at S44, and therefore, the rotation direction is determined to be clockwise, and the process of S8, for the case where the rotation direction of the jog dial input is clockwise, is performed.

[0059] When moving to coordinate P4, the distance from the coordinate P3 is 8.94, which is smaller than the minimum distance Lmin, and therefore in the process of S35 the variable D is assigned a value of "0" indicating that [the rotation direction] is indeterminable. Moreover, when moving to coordinate P5, the distance from the coordinate P3 [sic] is larger than the minimum distance Lmin and in the process of S37 the slope is computed to be -0.80, and therefore, in the process of S60 the variable G is assigned a value of "1," the variable D is assigned a value of "1" in S44, and the rotation direction is again determined to be clockwise. Next, when moving to coordinate P6, the move is vertical in the X-axial direction, and therefore in the process of S36 the variable VX is determined to be "0" and in the process of S35 the variable D is assigned a value of "0," indicating an indeterminable [rotation direction]. However, when moving to coordinate P7, in the process of S37 the slope is computed to be 6.50, in the process of S60 the variable G is assigned a value of "1," and in S44 the variable D is assigned a value of "1," and therefore the rotation direction is determined to be clockwise. Similarly, when moving to coordinate P8, the rotation direction is determined to be clockwise.

[0060] When moving to coordinate P9, in the process of S51, the distance from the prior-to-previous coordinate P7 is determined to be less than the minimum distance Lmin, and therefore, in the process of S52 the sign of the variable G is reversed to "-1" and the rotation direction is determined to be counterclockwise. Moreover, when moving to coordinate P10, in the process of S62 the variable G is assigned a value of "-1" so that the direction rotation is again determined to be counterclockwise. Then, when this type of counterclockwise determination is made, the process of S9, for the case where the rotation direction of the jog dial inputs is counterclockwise, is performed.

[0061] When moving to coordinate P11, the slope computed in the process of S37 is 10.63, and in the process of S53 the slope is determined to be the same as that of the previous coordinate P10, and therefore the process of S54 assigns a value of "0" to the variable D, indicating an indeterminable state. When moving to coordinate P12, however, in the process of S53 the slope is computed to be the same as that of the previous coordinate P10, and therefore the process of S54 assigns a value of "0" to the variable D, indicating an indeterminable state. However, when moving to coordinate P12, the slope computed in the process of S37 is 14.42, and therefore in the process of S57 the variable G is assigned a value of "1," and [the program] returns to determine that the rotation direction is clockwise. Here, after the moving to coordinate P11 and completing the process of S54, the process of S42 is skipped and the processing of jog dial mode inputs is terminated directly.

[0062] With the above-described constitution, an input operation similar to using a jog dial input device can be achieved by

tracing a circle or arc with a fingertip A on the panel surface 1a of the mouse pad, thereby enabling a long-stroke operation to be performed easily within a small operating area. Moreover, as shown in the flowcharts of FIGS. 6 and 7, the rotation direction is determined based on simple calculations of computing and comparing line segment slopes, thereby easily ensuring real-time operation.

[0063] In the present invention, the angular displacement of the previous and present line segments can be obtained with the above-described Equations 1 and 4. Thus, the rotation direction can easily be determined from the sign of the angular displacement obtained in this manner, and the concern for divide-by-zero errors would be eliminated. Moreover, sudden reversals of the rotation direction can be determined more accurately when the absolute value of the angular displacement approaches π. If the determination of rotation direction is based on the slope of line segments, as in this embodiment, the load on the processing unit is extremely light, thereby easily ensuring real-time operation.

[0064] [Embodiment 2] A second embodiment of the present invention is shown in FIG. 20, which is a flowchart explaining the operation of processing inputs from the mouse pad. Elements having the same functions as those of the first embodiment shown in FIGS. 1 to 7 are assigned the same reference numerals, and a description thereof is omitted herein.

[0065] This [second] embodiment has a configuration similar to that shown in FIGS. 1 to 3 and FIGS. 5 to 7 of the first embodiment, and as shown in FIG. 20, adds the processes of S11 to S13 to [those in the flowchart of] FIG. 4 of the first embodiment. The process of S11 provides, via the display driver 14 shown in FIG. 3, a display on the display device 15 indicating that the [rotation direction of] jog dial input is clockwise. S11 is inserted directly before the process of S8. Accordingly, this display indicating clockwise rotation is provided when the value of the variable G is determined to be "1" in S7 and the process of S8 for the case of clockwise jog dial input is performed. Moreover, the process of S12 provides a display on the same display device 15 indicating that the [rotation direction of] jog dial input is counterclockwise. S12 is inserted directly before the process of S9. Accordingly, this display indicating counterclockwise rotation is provided when the value of the variable G is determined to be "-1" in S7 and the process of S9 for the case of counterclockwise jog dial input is performed. Furthermore, the process of S13 provides a display on the same display device 15 indicating that there is no jog dial input. S13 is inserted directly before the process of S10. Accordingly, this display of no jog dial input is provided when the value of the variable D is determined to be "0" in S6 and the process of S10 for the case of no jog dial input is performed.

[0066] For example, the display of clockwise rotation can be indicated with the number "1" displayed in a certain area of the display device 15, the display of counterclockwise rotation can be indicated with the number "-1" displayed in the same area, and the display in the case of no input can be indicated with the number "0" displayed in the same area. Thus, the operator can view

these screen displays to verify whether the rotation direction is being recognized correctly while tracing his fingertip A in a circle or arc on the panel surface 1a of the mouse pad 1. The operation of tracing a circle or arc with a fingertip A can usually be performed easily by anyone, but in cases where an inexperienced operator traces a small circle for which [the rotation direction] is difficult to determine, for example, guidance is provided to enable the operator to input [coordinates] correctly.

[0067] These displays may also utilize arrow symbols and the like in accordance with the details of the operation. Moreover, in the flowchart above, the application program performs the processes of S11 to S13 and implements a display when performing the processes of S8 to S10. However, for example, when the computer-side device driver acquires from the mouse pad 1 the values of variables G and D indicating the result of a determination of the rotation direction, similar determinations as in S6 and S7 may be performed, and the processes of S11 to S13 executed.

[0068] [Embodiment 3] A third embodiment of the present invention is shown in FIG. 21, which is a flowchart explaining the operation of processing inputs from the mouse pad. Elements having the same functions as those of the first embodiment shown in FIGS. 1 to 7 are assigned the same reference numerals, and a description thereof is omitted herein.

[0069] This [third] embodiment also has a configuration similar to that shown in FIGS. 1 to 3 and FIGS. 5 to 7 of the first embodiment, and as shown in FIG. 21, adds the processes of S14 and S15 to [those in the flowchart of] FIG. 4 of the first embodiment. The process of S14 generates, via a sound driver 16 shown in FIG. 3, a sound on the speaker 17 indicating that the [rotation direction of] jog dial input is clockwise. S14 is inserted directly before the process of S8. Accordingly, this sound indicating clockwise rotation is generated when the value of the variable G is determined to be "1" in S7 and the process of S8 for the case of clockwise jog dial input is performed. Moreover, the process of S15 generates a sound on the same speaker 17 indicating that the [rotation direction of] jog dial input is counterclockwise. S15 is inserted directly before the process of S9. Accordingly, this sound indicating counterclockwise rotation is generated when the value of the variable G is determined to be "-1" in S7 and the process of S9 for the case of counterclockwise jog dial input is performed.

[0070] If the sound generated from the speaker 17 indicating clockwise rotation is a high-pitched tone, the sound indicating counterclockwise rotation can be a low-pitched tone, for example. Thus, similar to the display of rotation direction in the second embodiment, the operator can listen to these sounds to verify whether the rotation direction is being recognized correctly while tracing a circle or arc.

[0071] In addition to these generated sounds, other sounds and synthesized sounds or the like may also be used. Moreover, similar to the case of the second embodiment, the processes of S14 and S15 may be implemented by a device driver or the like.

[0072] [Fourth Embodiment] A fourth embodiment of the present invention is shown in FIG. 22, which is a flowchart explaining the operation of processing inputs from the mouse pad. Elements having the same functions as those of the first embodiment shown in FIGS. 1 to 7 are assigned the same reference numerals, and a description thereof is omitted herein.

[0073] This [fourth] embodiment also has a configuration similar to that shown in FIGS. 1 to 3 and FIGS. 5 to 7 of the first embodiment, and as shown in FIG. 22, substitutes the process of S16 for the process of S4 shown in FIG. 4 of the first embodiment. Substituting for the process of S4 wherein the value of the minimum distance Lmin stored in the minimum distance storage memory 8 shown in FIG. 1 is set to a default value, the process of S16 receives a numeric value inputted from the keyboard 13 shown in FIG. 3 and changes the value of the minimum distance Lmin to this inputted value. Accordingly, after the initialization processes of S1 to S3 in FIG. 22 have been performed, the operator can input a numeric value from the keyboard 13 and modify the minimum distance Lmin value. Thus, the minimum distance Lmin becomes the resolution when inputting in jog dial mode from the mouse pad 1, and can be changed arbitrarily by the operator according to the type of operation. For example, in order to select a menu item quickly [the operator] can rapidly trace a circle, but by changing the resolution to a finer setting so that there is an increase in the number of times the rotation direction is determined, high-speed selection is similarly possible.

[0074] In the flowchart above, the operation to change the minimum distance Lmin is performed when performing the jog dial mode initialization processes, but the process of S16 may be performed independently [of those initialization processes], and executed upon command from the keyboard 13 or the like, so that the change operation may be performed at an arbitrary time. Moreover, the minimum distance Lmin value may also be input using the mouse pad 1 or other input device, and is not limited to the above-described keyboard 13.

[0075] [Embodiment 5] A fifth embodiment of the present invention is shown in FIG. 23, which is a flowchart explaining the operation of processing inputs from the mouse pad. Elements having the same functions as those of the first embodiment shown in FIGS. 1 to 7 are assigned the same reference numerals, and a description thereof is omitted herein.

[0076] In the [fifth] embodiment above, an operation (not explicitly shown) from the mouse pad 1 switches between jog dial mode and mouse mode input processing. Accordingly, instead of using a dedicated operating space for processing jog dial mode inputs, input can be processed by switching between the jog dial mode and mouse mode. In this [fifth] embodiment, switching of the input mode easily accomplished according to whether a specified key is being pressed down on the keyboard 13 shown in FIG. 3.

[0077] This [fifth] embodiment also has a configuration similar to that shown in FIGS. 1 to 3 and FIGS. 5 to 7 of the first embodiment, but as shown in FIG. 23, add the processes of S17 to S20 to the processes shown in FIG. 4 of the first embodiment.

The process of S17 determines whether the specified key is being pressed down on the keyboard 13. S17 is inserted directly before the jog dial mode input process of S5. Thus, the subsequent processes of S5 to S10 are performed only when the [specified] key is being pressed down.

[0078] If the above-described specified key is not being pressed down, the processes of S18 to S20 are performed. S18 processes mouse mode input from the mouse pad 1, and in this case the mouse pad 1 emulates the operation of a mouse. Moreover, S19 is a process executed by the application program or the like based on mouse inputs obtained from the mouse mode input process. Furthermore, after the process based on the mouse inputs is completed, a determination is made at the process of S20 as to whether the same specified key as in the above-described S17 is being pressed down. Then, if the specified key is not being pressed down, [the program] returns to S18 and the mouse mode input process continues. However, if the specified key was pressed down, [the program] returns to S1, and after performing a jog dial mode initialization process, while this key is being pressed down, the jog dial mode input process is performed.

[0079] The jog dial mode input process is mostly used for special input processes only. Accordingly, the operator can normally process mouse mode inputs, and only in cases where the need arises to scroll across a large screen, for example, can press down the specified key to process jog dial mode inputs, and therefore the switching between operations is trouble-free.

[0080] The Alt key (ALT), control key (CTRL), shift key (SHIFT) and other keys not usually used by themselves, or special-use function keys and the like are appropriate for use as the specified key.

[0081] Moreover, the implementation of input mode switching may be based not only on the pressed state of a specified key as described above, but also on other operations from the keyboard 13, the mouse pad 1 or other input devices.

[0082]

[Effect of the Invention] As described above, with the jog dial emulation input device of the present invention, by tracing a circle or arc on an ordinary coordinate input device, instead of inputting [coordinates] with a jog dial input device, stroke input with a mouse or the like can be implemented in a jog dial-like manner, thereby enabling long-stroke input operations to be performed easily within a small operating area without connecting a dedicated jog dial input device.

[0083] Moreover, the operation of tracing a circle or arc with this coordinate input device can be verified with a display on a display device or by sound so that the input operation can be performed accurately and easily.

[0084] Further, the resolution of the operation of tracing a circle or arc with this coordinate input device is easily changed, and

the resolution can be selected in accordance with the operator and the type of operation.

[0085] Further, the input process is easily changeable between the jog dial mode and the mouse mode, thereby saving the space and cost [that would otherwise be needed] for installing two types of input devices.

[0086] Further, since the rotation direction can be detected based on simple slope computations and comparison calculations, the load on the processing unit is light, thereby easily ensuring real-time operation.

[Brief Explanation of the Drawings]

[FIG. 1] shows a first embodiment of the present invention, and is a flowchart illustrating the hardware configuration of a mouse pad.

[FIG. 2] shows a first embodiment of the present invention, and is a plan view of the mouse pad.

[FIG. 3] shows a first embodiment of the present invention, and is a block diagram illustrating the hardware configuration of a computer connected to the mouse pad.

[FIG. 4] shows a first embodiment of the present invention, and is a flowchart illustrating the processing of inputs from a mouse pad.

[FIG. 5] shows a first embodiment of the present invention, and is a flowchart illustrating the processing of coordinates input from the mouse pad.

[FIG. 6] shows a first embodiment of the present invention, and is a flowchart illustrating the processing of jog dial mode inputs from the mouse pad.

[FIG. 7] shows a first embodiment of the present invention, and is a flowchart illustrating the process for determining the rotation direction on the mouse pad.

[FIG. 8] shows a first embodiment of the present invention, and is a diagram illustrating a case in which the rotation direction of the coordinates is suddenly reversed.

[FIG. 9] shows a first embodiment of the present invention, and is a diagram illustrating cases in which the rotation direction of the coordinates is clockwise.

[FIG. 10] shows a first embodiment of the present invention, and is a diagram illustrating cases in which the rotation direction of the coordinates is counterclockwise.

[FIG. 11] shows a first embodiment of the present invention, and is a diagram illustrating a case in which the rotation direction of the coordinates is clockwise.

[FIG. 12] shows a first embodiment of the present invention, and is a diagram illustrating a case in which the rotation direction of the coordinates is clockwise.

[FIG. 13] shows a first embodiment of the present invention, and is a diagram illustrating a case in which the rotation direction of the coordinates is counterclockwise.

[FIG. 14] shows a first embodiment of the present invention, and is a diagram illustrating a case in which the rotation direction of the coordinates is counterclockwise.

[FIG. 15] shows a first embodiment of the present invention, and is a diagram illustrating cases in which the rotation direction of the coordinates is clockwise.

[FIG. 16] shows a first embodiment of the present invention, and is a diagram illustrating cases in which the rotation direction of the coordinates is clockwise.

[FIG. 17] shows a first embodiment of the present invention, and is a diagram illustrating cases in which the rotation direction of the coordinates is counterclockwise.

[FIG. 18] shows a first embodiment of the present invention, and is a diagram illustrating cases in which the rotation direction of the coordinates is counterclockwise.

[FIG. 19] shows a first embodiment of the present invention, and is a diagram illustrating the processing of inputs when the coordinates move consecutively.

[FIG. 20] shows a second embodiment of the present invention, and is a flowchart illustrating the processing of inputs from the mouse pad.

[FIG. 21] shows a third embodiment of the present invention, and is a flowchart illustrating the processing of inputs from the mouse pad.

[FIG. 22] shows a fourth embodiment of the present invention, and is a flowchart illustrating the processing of inputs from the mouse pad.

[FIG. 23] shows a fifth embodiment of the present invention, and is a flowchart illustrating the processing of inputs from the mouse pad.

[FIG. 24] shows a conventional example, and is a plan view of a jog dial input device.

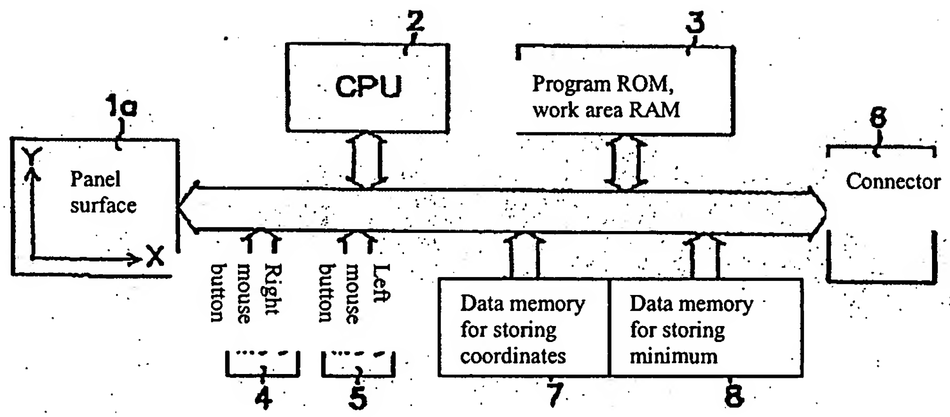
[FIG. 25] shows a conventional example, and is a diagram of a display screen and tablet illustrating operation in the case when using a stylus pen to select a menu item.

[FIG. 26] shows a convention example, and is a diagram illustrating a method for computing angular displacement caused by movement of coordinates.

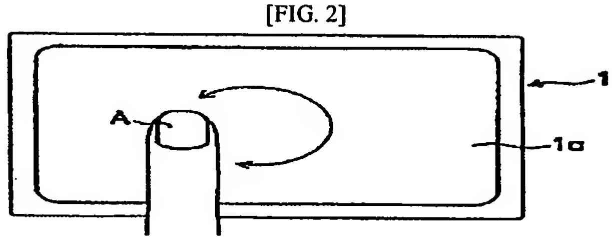
[Explanation of Reference Numerals]

1:	Mouse pad
1a:	Panel surface
7:	Memory for storing coordinates
8:	Memory for storing minimum distance
13:	Keyboard
15:	Display device
17:	Speaker

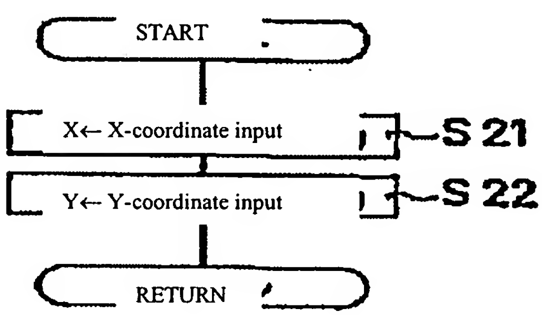
[FIG. 1]



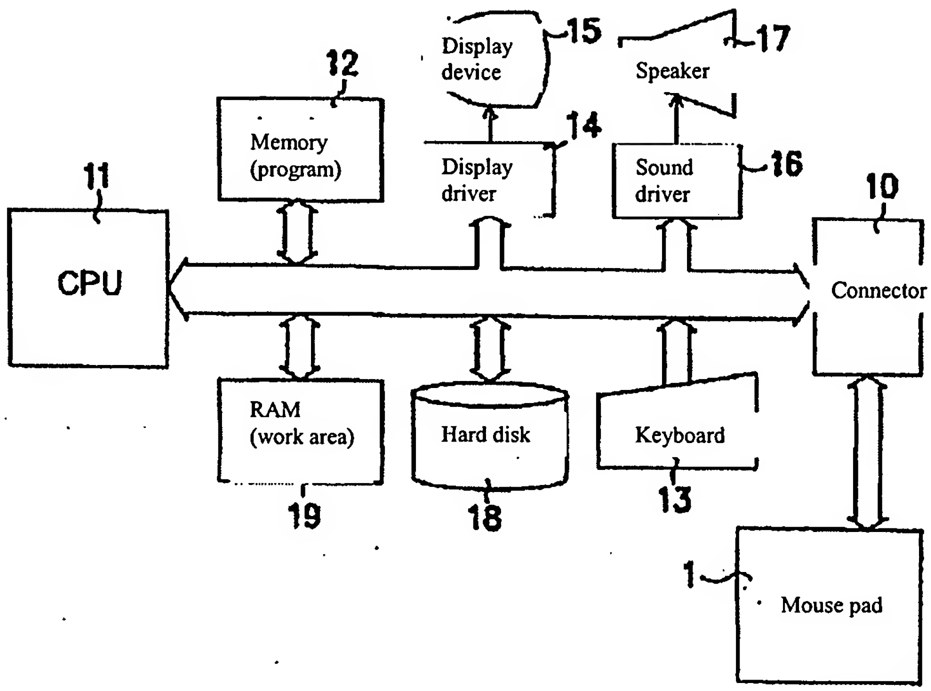
[FIG. 2]



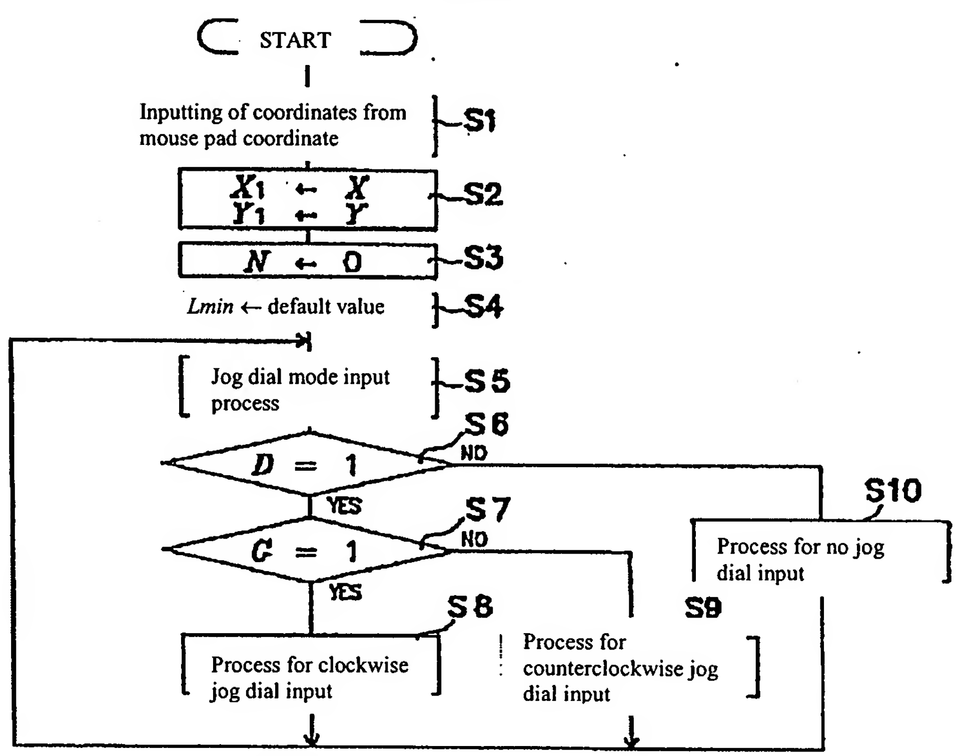
[FIG. 5]



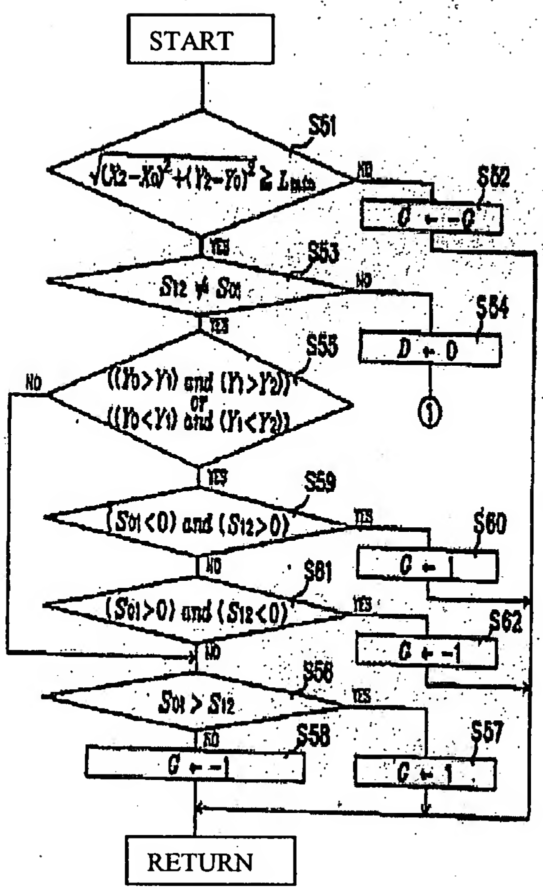
[FIG. 3]


Display device
15
Speaker
17
12
Memory (program)
14
Display driver
Sound driver
16
11
10
CPU
Connector
RAM (work area)
Hard disk
Keyboard
19
18
13
1
Mouse pad

[FIG. 4]


START
Inputting of coordinates from mouse pad coordinate
S1
X1 ← X
Y1 ← Y
S2
N ← 0
S3
Lmin ← default value
S4
Jog dial mode input process
S5
S6
NO
D = 1
YES
S7
NO
C = 1
YES
S10
Process for no jog dial input
S8
S9
Process for clockwise jog dial input
Process for counterclockwise jog dial input

[FIG 7]



[FIG 8]

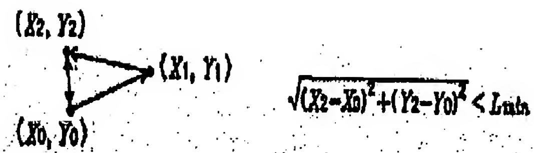
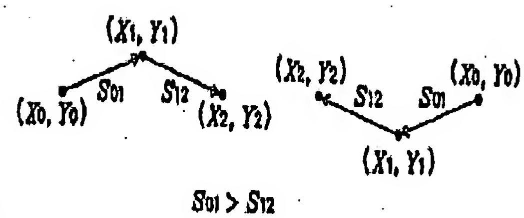
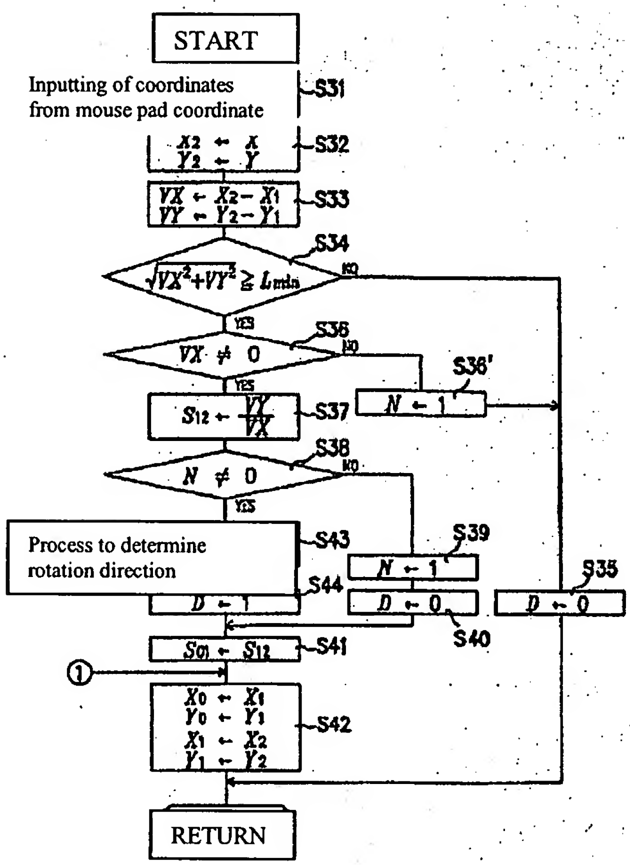


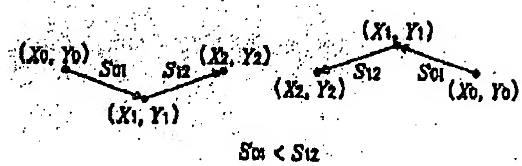
FIG 9



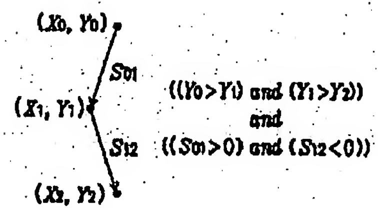
[FIG 6]



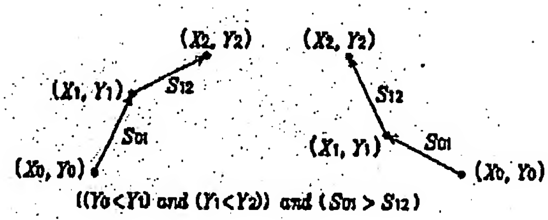
[FIG 10]



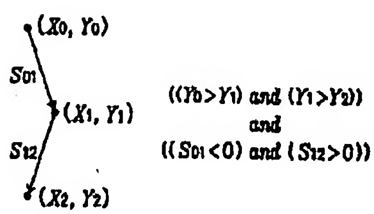
[FIG 13]



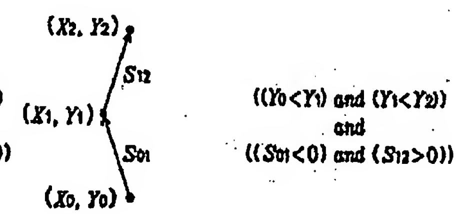
[FIG 16]



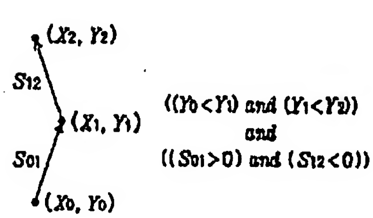
[FIG 11]



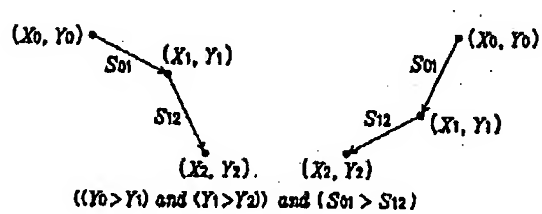
[FIG 12]



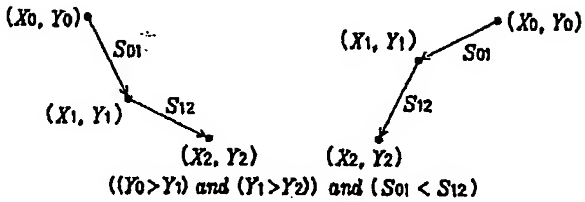
[FIG 14]



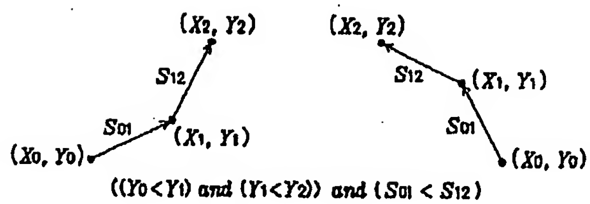
[FIG 15]



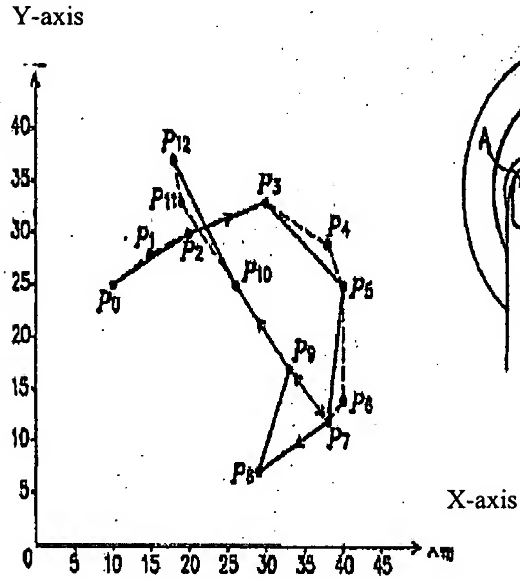
[FIG. 17]



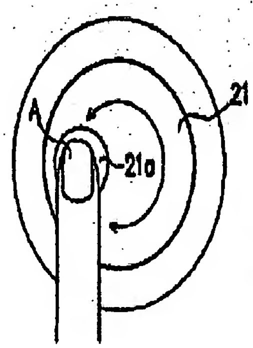
[FIG. 18]



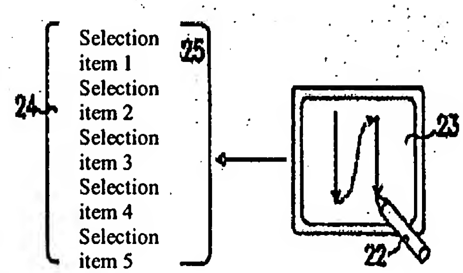
[FIG 19]



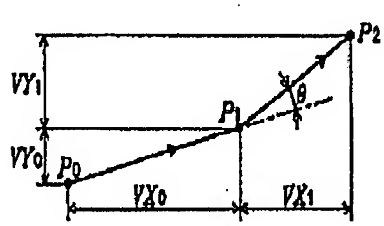
[FIG 24]



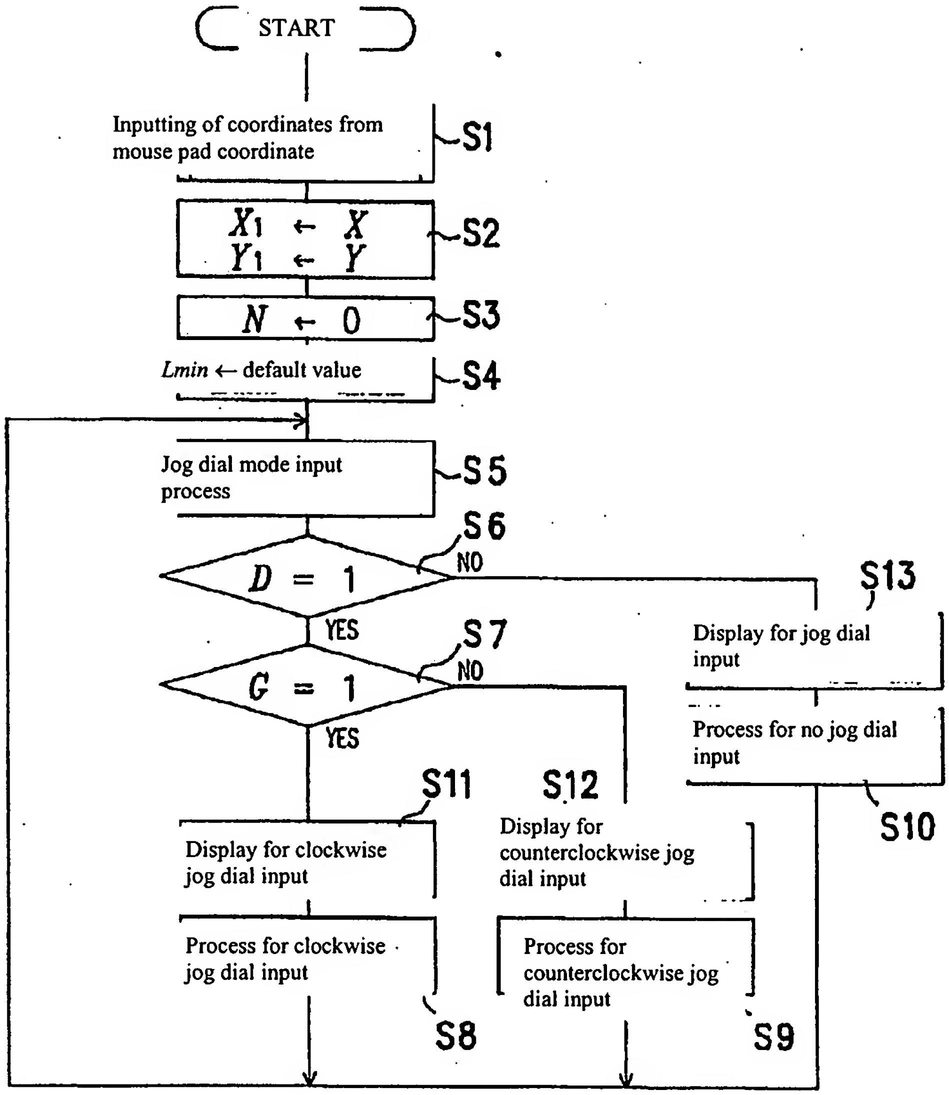
[FIG 25]



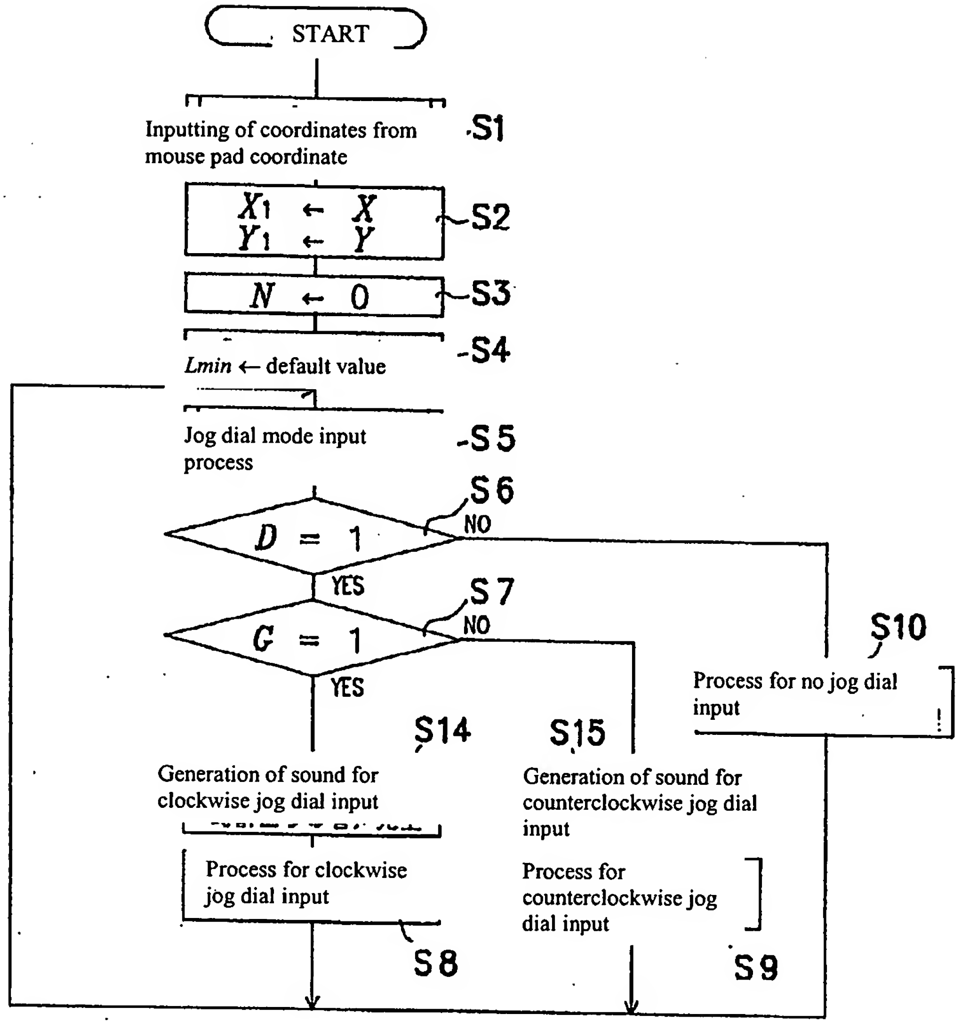
[FIG 26]



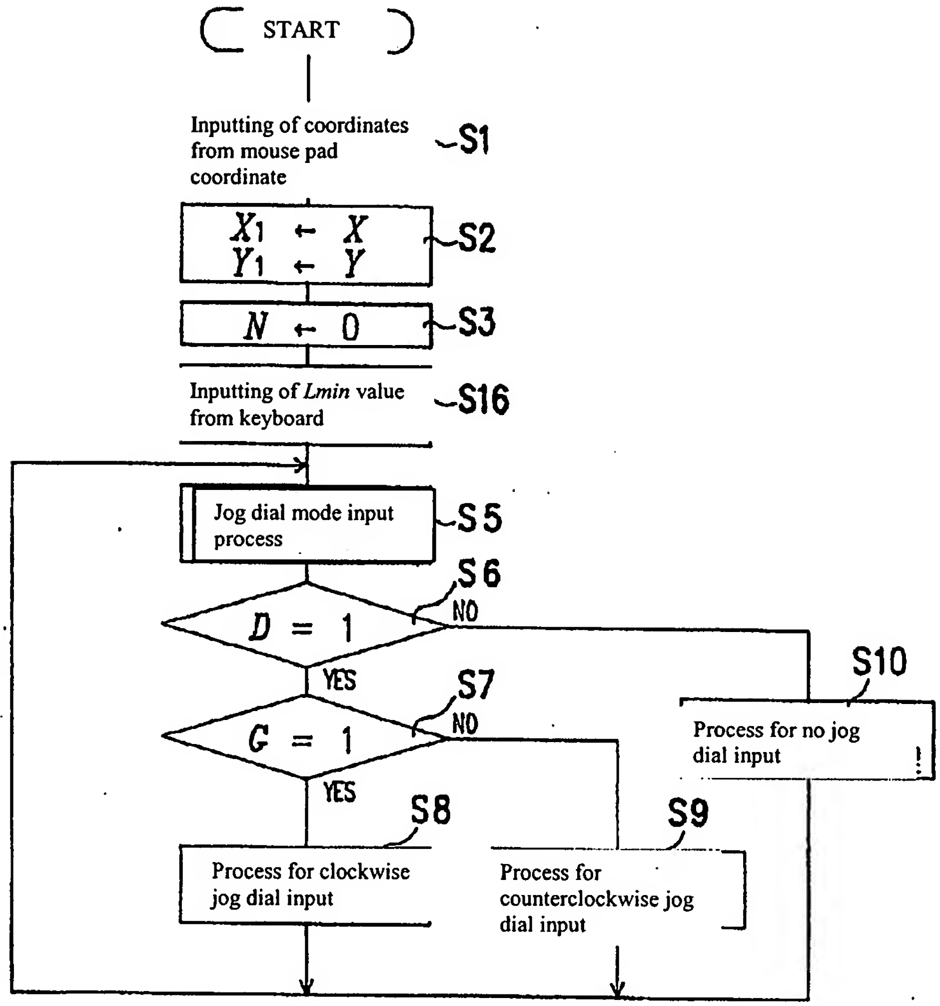
[FIG. 20]


START
Inputting of coordinates from mouse pad coordinate
S1
X1 ← X
Y1 ← Y
S2
N ← 0
S3
Lmin ← default value
S4
Jog dial mode input process
S5
S6
D = 1
NO
YES
S7
G = 1
NO
YES
S13
Display for jog dial input
Process for no jog dial input
S10
S11
Display for clockwise jog dial input
Process for clockwise jog dial input
S8
S12
Display for counterclockwise jog dial input
Process for counterclockwise jog dial input
S9

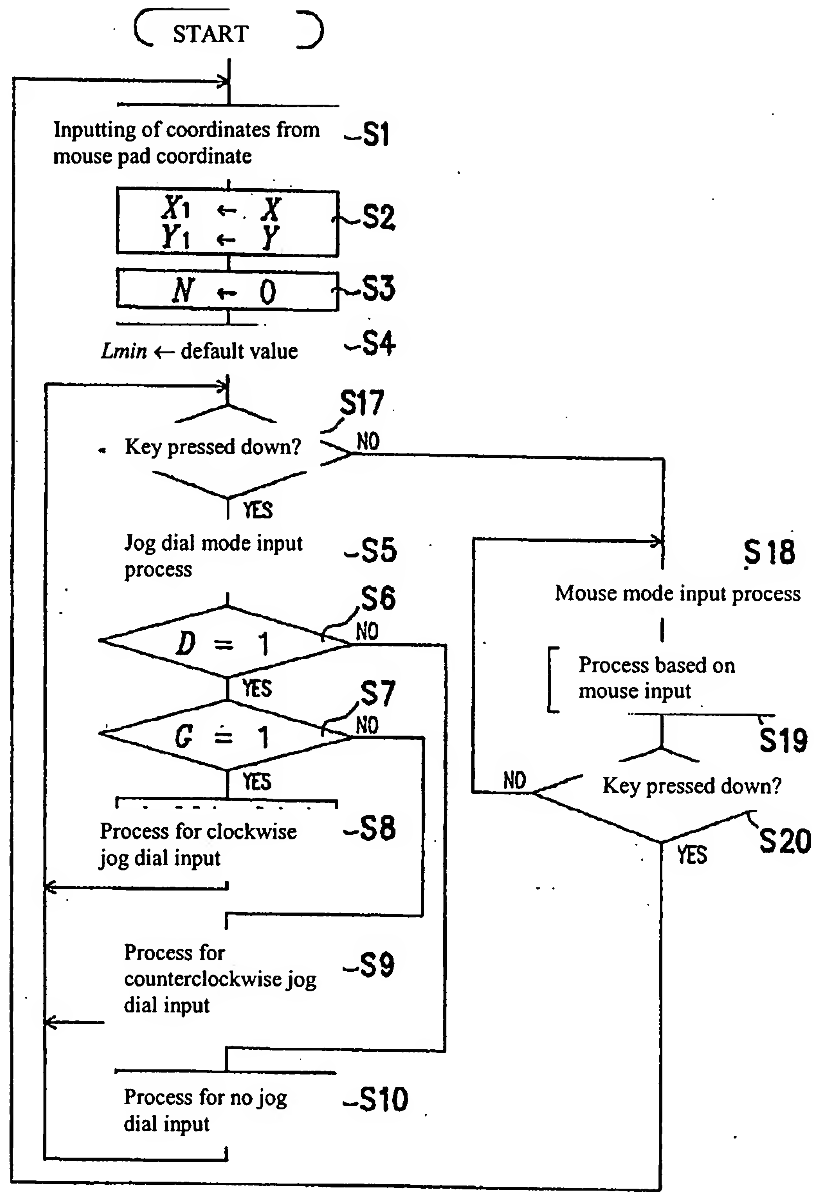
[FIG. 21]


START
Inputting of coordinates from mouse pad coordinate
S1
$X_1 \leftarrow X$
$Y_1 \leftarrow Y$
S2
$N \leftarrow 0$
S3
$Lmin \leftarrow$ default value
S4
Jog dial mode input process
S5
S6
$D = 1$
NO
YES
S7
$C = 1$
NO
YES
S10
Process for no jog dial input
S14
S15
Generation of sound for clockwise jog dial input
Generation of sound for counterclockwise jog dial input
Process for clockwise jog dial input
Process for counterclockwise jog dial input
S8
S9

[FIG. 22]


START
Inputting of coordinates from mouse pad coordinate
S1
$X_1 \leftarrow X$
$Y_1 \leftarrow Y$
S2
$N \leftarrow 0$
S3
Inputting of *Lmin* value from keyboard
S16
Jog dial mode input process
S5
S6
$D = 1$
NO
YES
S7
$G = 1$
NO
YES
S8
Process for clockwise jog dial input
S9
Process for counterclockwise jog dial input
S10
Process for no jog dial input

[FIG. 23]


START
Inputting of coordinates from mouse pad coordinate
S1
X1 ← X
Y1 ← Y
S2
N ← 0
S3
Lmin ← default value
S4
S17
Key pressed down?
NO
YES
Jog dial mode input process
S5
S6
D = 1
NO
YES
S7
G = 1
NO
YES
Process for clockwise jog dial input
S8
Process for counterclockwise jog dial input
S9
Process for no jog dial input
S10
S18
Mouse mode input process
Process based on mouse input
S19
NO
Key pressed down?
YES
S20